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CHAPTER ELEVEN:

PAVEMENT TRAFFIC MARKINGS

The furnishing, installing, or removing of traffic markings and snowplowable pavement markers is required to conform with the MUTCD (Manual of Uniform Traffic Control Devices), the Standard Specifications, and the plans. The technician is responsible for ensuring that the material is tested or certified, installed correctly, and inspected during and at the end of the warranty period for signs of failure where warranties are required.

TYPES OF MARKINGS

TEMPORARY MARKINGS

Temporary pavement markings are placed and maintained during the construction stage. They are used in lieu of permanent traffic markings.

The Specifications describe the types of materials that may be used for temporary markings and the placement and payment of these markings. Sections **801.12**, **801.17** and **801.18**, include the requirements for temporary pavement markings.

LONGITUDINAL MARKINGS

Longitudinal markings consist of centerlines, lane lines, edge lines, and barrier lines. Lines may be either continuous (solid) or broken. Broken lines consist of 10-foot line segments with 30-foot gaps. New broken lines placed over existing broken lines are required to match the existing line laterally and be within 10 percent of either end of the existing line segments.

Centerlines are used to separate lanes of traffic moving in the opposite direction. All centerlines are yellow and 4 inches wide. A double solid line is used for the centerline of multi-lane roadways. The centerline of a two-lane, two-way roadway where passing is allowed in both directions is marked with a broken line. For two-lane, two-way roadways where passing is allowed only in one direction, a double line (one broken and one solid) is used and spaced 8 inches apart. Extreme care is required to be taken to ensure that the solid line designating the no passing zone is exactly as specified. The actual limits for no markings is determined by the PE/PS.

Lane lines are used to separate lanes of traffic moving in the same direction. Normal lane lines are white and broken.

Center lines and lane lines should not be continued through intersections of public roads; however, they should be continued past driveways.

Edge lines are used to outline and separate the outside edge of pavement from the shoulder. Right edge lines are marked with a solid white line and left edge lines are marked with a solid yellow line. Gaps in the edge line are to be provided for all interchanges and crossovers on interstate highways. The markings should be placed in accordance with the striping pattern shown on the plan sheets.

Barrier lines are solid lines of the color and size specified.

All double line markings, such as a no passing zone or the centerline of an undivided multi-lane roadway, are required to be applied in one pass.

The traffic markings for a typical four-lane divided roadway are shown in Figure 11-1. The right edge line is solid white, the lane line is a broken white line, and the left edge line is solid yellow line.

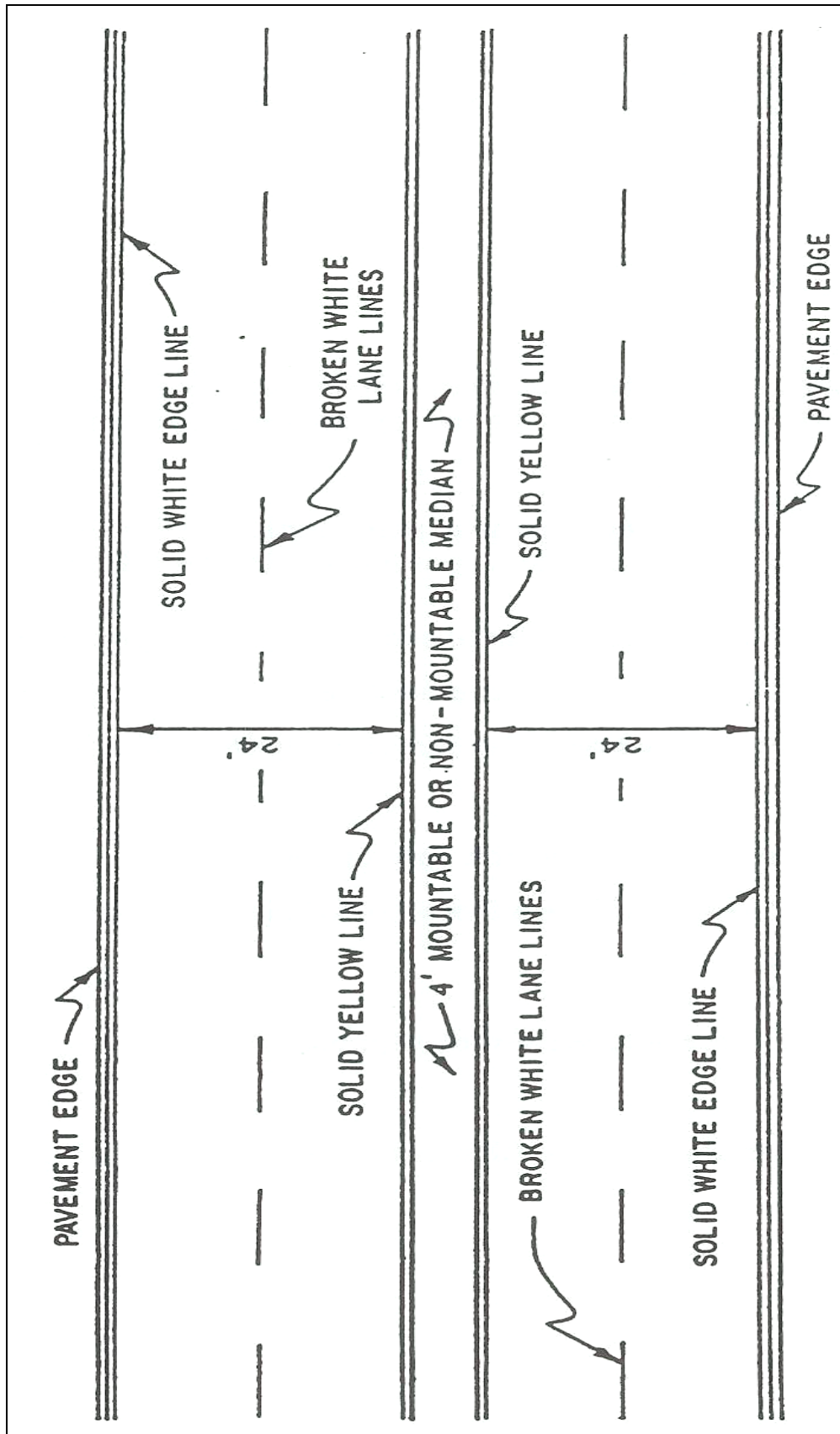


Figure 11-1. Traffic Marking for Four-Lane Divided Road

TRANSVERSE MARKINGS

Transverse markings include such items as channelizing lines, stop bars, crosswalk lines, railroad crossing approaches, parking limit lines, turn arrows, and word or symbol messages. These markings should be placed at the locations shown on the plans.

MARKING MATERIALS

Marking materials include traffic paint, thermoplastic, preformed plastic, epoxy, and snowplowable raised pavement markers. Thermoplastic, preformed plastic, and epoxy are more durable materials than paint.

SURFACE PREPARATION

The pavement is required to be cleaned of all dirt, oil, grease, excess sealing material, excess pavement marking material, and all other foreign matter before applying new pavement marking materials. The pavement surface is required to be dry.

PAINT

Traffic paint may be applied only when the pavement temperature is 40°F or above. Painted lines and markings are required to be immediately reflectorized by applying glass beads to the fresh paint uniformly at the specified rate.

A spray type machine capable of applying the traffic paint under pressure through a nozzle directly onto the pavement is required. The machine is required to be equipped with the following:

- 1) An air blast device for cleaning the pavement ahead of the painting operation
- 2) A guide pointer to keep the machine on an accurate line
- 3) At least two spray guns that may be operated individually or simultaneously
- 4) Paint agitators
- 5) A control device to maintain uniform flow and application
- 6) An automatic device that provides a broken line of the required length
- 7) An automatic bead dispenser

When fast drying paint is used, the machine is required to heat the paint to a maximum of 180°F.

A small hand-propelled machine designed for paint application or a brush may be approved to apply some paint markings.

THERMOPLASTIC

Thermoplastic material is supplied in solid form and heated to a plastic state for application. This material is normally used on HMA pavements. The pavement surface is required to be primed with an asphalt material in accordance with manufacturer's recommendations. The thermoplastic material is applied in molten form by spray, extrusions, or ribbon-type extrusion airless spray. The temperature of the pavement is required to be 50°F or higher. The average thickness of any 36 inch length of thermoplastic marking is required to be between 3/32 of an inch and 3/16 of an inch. Immediately following the application of the thermoplastic marking, glass beads are applied to the surface of the molten material to provide additional reflectorization. Beads are applied at a uniform minimum rate of 6 pounds per 100 square feet of marking. At this rate, one pound of glass beads would cover 50 lineal feet of continuous solid line 4 inches wide or the equivalent amount of broken line.

The thermoplastic material sets up in approximately two minutes at a surface temperature of 50°F and in approximately 15 minutes or less at 90°F.

The machine used for spray application of thermoplastic markings consists of two major components: a kettle for melting the material and an applicator. The equipment should maintain a uniform material temperature within the specified limits without scorching, discoloring, or overheating any portion of the material. The machine is required to have the same equipment as that specified for paint.

PREFORMED PLASTIC

Preformed plastic is a homogenous plastic film at least 60 mils thick and of the width specified. The preformed plastic has a precoated adhesive and an easily removed backing to protect the adhesive in storage and to permit rapid application. The adhesive allows the preformed plastic material to be re-positioned on the pavement surface before the material is permanently set into position by the rollers. Preformed plastic material is furnished in rolls.

The preformed plastic may be used on either HMA or concrete pavement. The material molds itself to pavement contours, breaks, and faults under traffic at normal pavement temperatures.

Preformed plastic markings may be applied only when the air temperature is 60°F and rising and when the pavement temperature is 70°F or higher. The pavement surface is required to be primed with an asphalt material in accordance with manufacturer's recommendations.

The equipment for applying preformed plastic markings is required to:

- 1) Be a portable hand-propelled machine capable of carrying and applying at least two rolls of either 4 or 6 inch plastic
- 2) Be equipped with a guide pointer to keep the machine on an accurate line
- 3) Be equipped with guide rollers and a pressure roller which is at least 2 inches wider than the width of the marking material and weigh a minimum of 200 lb to satisfactorily press the marking material onto the pavement
- 4) Feed the material from its original carton through the guide rollers and under the pressure roller onto the pavement
- 5) Be capable of removing the backing paper from the material during the application process

Preformed plastic furnished in strip, symbol, or legend form is applied with suitable equipment such as hand rollers.

EPOXY

Epoxy is a two component material: pigment and epoxy resins and a curing agent. The manufacturer's recommendations should be followed for the mixing ratio of the components. The ratio cannot vary by more than plus or minus 2 1/2 percent during the mixing or application procedures.

Epoxy is normally used on portland cement concrete pavements.

Epoxy may be applied only when the pavement temperature is 40°F or above. The wet film thickness is required to be at least 0.015 inch (1/64 inch.). Immediately following the application of the epoxy markings, glass beads are applied to the wet surface at the rate of 20 pounds per 100 square feet of marking. At this rate, one pound of beads would cover 15 lineal feet of 4-inch wide marking.

The machine used to apply the epoxy marking material is required to precisely meter the two components and produce and maintain the necessary mixing head temperature in accordance with the manufacturer's recommendations. The machine is required to be equipped with:

- 1) A high pressure water blast device ahead of a high pressure air blast device, both as an integral part of the gun carriage, for cleaning the pavement ahead of the marking application
- 2) A guide pointer to keep the machine on an accurate line
- 3) At least two spray guns which may be operated individually or simultaneously
- 4) An automatic device that provides a broken line of the required length
- 5) Automatic glass bead dispenser(s) synchronized with the marking application

WARRANTY FOR DURABLE PAVEMENT MARKING MATERIAL

On INDOT contracts, thermoplastic, preformed plastic, and epoxy pavement marking materials are required to be warranted for 180 days following the last working day of the contract as defined in the final acceptance letter, or November 1st of the year in which the last markers were placed, whichever is later. On federal-aid contracts, this requirement applies to only thermoplastic material.

If more than 3 percent of a unit or 3 percent of the total of any one intersection or set of transverse markings fails, the failed portion is required to be replaced. All replacements are required to be completed within 60 days following notification of the failure.

SNOWPLOWABLE RAISED PAVEMENT MARKERS

Permanent snowplowable raised pavement markers are markers that are inset into the pavement. Both ends of the markers are shaped to deflect a snowplow blade upwards. The pavement or bridge deck surfaces that receive these markers are required to be cleaned of dirt, oil, grease, moisture, curing compound, and loose or unsound layers of material which would interfere with the proper bonding of the marker.

Marker locations and colors are shown on the plans. The Contractors lay out the locations, which are then inspected to ensure the accuracy of location. Markers are not installed on surfaces that show visible evidence of cracking, checking, spalling or failure or within intersections of a public road.

Any marker location that falls on any of the restricted areas is moved longitudinally up to 10 percent of the required marker spacing. If this adjusted location is still within a restricted area, the marker is omitted.

The Contractor is allowed to cut only the number of installation slots in which markers may be installed in one day. No slots may be left open overnight.

The manufacturer's recommendations are followed for installing the markers. The temperatures of both the pavement surface and the air are required to be at least 50°F and the pavement surface-dry. The installation slot is required to be clean and dry. The slot is filled with sufficient adhesive to provide a water tight seal between the marker base and the bottom of the slot and to fill all voids between the marker base and the surfaces of the slot. The marker is placed in the slot so that the tips of the snowplow deflecting surfaces are below the pavement surface.

Two days are required for curing before installing the markers on any newly placed HMA surfaces. For newly placed HMA sand mix surfaces, the curing period is 21 days. Installation of markers on new concrete pavement, bridge decks, or newly overlaid bridge decks are required to be delayed until the new concrete has cured long enough to comply with the requirements for opening to traffic.

MAINTENANCE OF TRAFFIC

Frequently, traffic markings are applied after the contract has been opened to traffic. Proper traffic control is essential to protect the traveling public, the pavement marking crews, and the pavement markings during the curing period. The traffic control procedures in Chapter Three and in the MUTCD should be followed. The following additional precautions may also be necessary when marking under traffic:

- 1) Each vehicle in the marking operation is required to display a slow moving vehicle emblem when operating at speeds of 25 miles per hour or less. (These signs are removed when operating above 25 miles per hour.)
- 2) Every vehicle in the operation is required to have at least one flashing amber warning light which is visible from all directions.
- 3) When marking material requires more than 60 seconds of drying time, cones are used to protect the material from damage by traffic.

- 4) A front escort vehicle is required to be provided when the marking vehicle extends across the centerline. The vehicle is required to be equipped with a forward facing paint crew sign, a rear facing slow moving vehicle emblem, and a red flag mounted at least 10 feet above the pavement.
- 5) Marking vehicles are required to have a rear facing Type A or Type C flashing arrow sign, an amber flashing warning light mounted near the center of the truck bed, and an amber strobe light mounted on each rear corner of the truck bed. The amber warning and strobe lights are mounted on retractable supports and are operated at a height of 12 feet above the pavement.
- 6) A rear escort vehicle is required to follow the marking vehicle at a distance of 100 to 500 feet, unless cones are required because of drying time. If cones are required, the cone setting truck follows the marking truck and the rear escort vehicle follows the cone setting truck. The cone pick up truck is followed by an additional rear escort vehicle.

All rear escort vehicles are equipped with a rear facing Type C flashing arrow mounted above a rear facing paint crew sign. On two-lane two-way roads, the Type C flashing arrow sign is operated with the arrowhead turned off and only the bar flashing.

PAVEMENT MARKING REMOVAL

Pavement markings which conflict with revised traffic patterns and confuse motorists should be removed before or immediately after the change in traffic patterns is made.

Pavement markings may be removed by sandblasting, waterblasting, grinding, or other approved mechanical methods. The removal methods should, to the fullest extent possible, cause no significant damage to the pavement surface. Grooving is not permitted and grinding is permitted only for removing thermoplastic or epoxy pavement markings. Painting over existing markings to obliterate the markings does not work and is not permitted.

When a blast method is used to remove pavement markings, the residue, including sand, dust, and marking material, is required to be vacuumed concurrently with the blasting operation or removed by other approved methods.

Any damage to the pavement caused by pavement marking removal is repaired by approved methods with no additional payment.

PAYMENT

Pavement markings are measured and paid for as follows:

- 1) Broken lines, placed or removed, are measured as $\frac{1}{4}$ of the total linear distance in feet of the broken line pattern after excluding any openings such as gaps at intersections
- 2) Solid lines are measured as the total linear foot of solid line placed or removed
- 3) Transverse markings are measured by the total number of each type placed or removed
- 4) Snowplowable markers are counted (the number placed or removed) with no additional compensation for the adhesive, hole patching material, or the like.